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An Indian Globe

K.V. Ramakrishna Rao B.Sc., M.A., A.M.I.E., C.Eng. (I)., B.L.,

Introduction: It was Roberto de Nobili, who recorded that Johannes Kepler wanted to discuss his laws[1] in India so that they could be safely declared to the world fearing inquisition from the Church from one side and criticism from the other scientists at the other side. When the material pertaining to Roberto de Nobili and Johannes Kepler were studied, in the book of Tycho Bahe on Mechanics, in which, he mentions about many armillary spheres and globes[2]. So, there is evident that Indian had many astronomical instruments, but, they have been destroyed, removed, taken away and so on, so that the present Indians do not know anything about their scientific achievements and go on studying history books that they are useless idiots, always getting everything from the west and so on. When looking for the spheres and globes of Indian, one Persian globe[3] has been depicted mentioning as "astrological globe". The so-called Indo-Persian Celestial globe appeared Indian and hence, it was also known as "Indian astrological globe", as Indians have been fools enough to looking for the astrological predictions instead of playing with telescopes. Kapil Raj in his book[4], he gives the following details:

- At least half a dozen cosmographic globes all largely based on the Puranas, are known to have existed and are held n various collections in Britain and India.
- The oldest and perhaps most fascinating of these is the bugola of Ksema Karna (□□□□□□□□□□)[5], a globe shaped brass container intricately etched to indicate the various components of the earth based on the Puranic sources.
- But modified in the light of knowledge of the post-Ptolemaic Sanskrit astronomers.
- It was most probably made to hold spices.

The last mentioned usage was intriguing, as he has not given the details of how the brass container was modified in the light of knowledge of the post-Ptolemaic Sanskrit astronomers and why not modified by the post-Ptolemaic Sanskrit astronomers, and having accepted that it is a globe, the tail remarks appear to cast aspersion on the very material evidence, he pointed out.

When the first Globe model was made?: The oldest surviving terrestrial globe, known as the Erdapfel, was made in 1492 by Martin Behaim in Nuremberg, Germany. In Indian context, the literary evidences point to Varaha carrying earth / globe, after rescuing from the submergence. Later from the Kushana period onwards, such depictions were made in the sculptures. From the

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Gupta period onwards, such depictions multiplied. Even in the Punch Marked coins, such imagery is found.

What Tycho Brahe (1546-1601) Recoded about Indian Globes: About his involvement in transmission of Nilakanta Somasutvan (1444-1550) works to Europe, studies have already been published. Here, his dealing with astronomical instruments is studied. In his preface to "Mechanica" to the Noblest Emperor Rudolph the 2nd, he comes out with the following details[6]:

- God made men to discover astronomy etc., because it is "divine astronomy" and make instruments following the Christian Prophets.
- Many other devices that were constructed for this purpose by the most ancient kings were once observed, such as in India, Syria, Arabia. Chaldea, Ethiopia, Egypt.
- The Arabs used zodiac armillaries (armillary sphere), torquetum, plane astrolabe.
- He laments about many other astronomical instruments that might be perished due to frequent changes of the world.
- He accepts that recently (in 16th-17th centuries), the instruments used were quadrant, radius, astronomical ring.
- About the usage of astronomical instruments by Copernicus, he records that "partly from those instruments considered to have been used by him that which still remain".
- Then, he explains how he tried to construct "astronomical instruments" since childhood but failed.
- He notes that "Ptolemy is seen to complain loudly about the same kind of instruments, which were made of solid metal and once used to stand in the Colonnade at Alexandria", but he was making with wood.
- He mentions about "a certain very large quadrant intended for altitudes only, which I once used at Ausburg, in my youth". Then, he mentions about the instruments he *purchased* without mentioning the source.
- "a certain steel quadrant, which I *brought up* earlier" –
- About his instruments, he says, "*…..my instruments, which are not yet drawn and which I am not ready to exhibit, where also is added some indication of those that I am still thinking of constructing to great advantage*".
- Finally, he mentions about a "*very great globe made of brass, which comprehends 1000 fixed stars that were placed by me with the greatest care and precision many years ago now….*"

So the mention of "brass globe", outside India no such evidence has been found. As he had not mentioned the source, where he obtained, but his acknowledging India as one of the countries, where many observing instruments were constructed and his derivation of planetary theory from Nilakanta Somasutvan (1444-1550) prove that he must have obtained from India. Again comes brass globe, this time, at least, it has been accepted as Indian!

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The Nexus between Rubino-Ricci-Nobili and Brahe-Galeleo-Kepler groups: In 1609, some of the discoveries of Galileo Galeli (1564-1642) were confirmed at the Roman College and news of them reached India by way of Antonio Rubino (1590-1608), a Piedmontese missionary with astronomical interest. Through him, Nobili knew the details and applied in his dialogue with the Brahmins, as he thought that they might not be knowing such new discoveries. But they started arguing from their books that they knew already including the planetary motion and the distance between them. Knowing Indian method of calculation of distances using different units like kadham, naligai etc., he decided that they did not know how to calculate the distances between the planets accurately as appearing in their astronomical books like Vulogathuva Sasthiram. The terminology proves that they were possessing Tamil Palm-leaf-books on astronomy and discussing. So he thought that they required Kepler law of elliptical orbits. So he started introducing such new observations to Indians, which were ridiculed by many even in Italy, not for themselves alone, as empirical facts, but to arouse (as in the Vedas) a sense of God. But, they again proved with their books that they knew the planetary motion in elliptical orbits. So then, he came out with the argument that their astronomers used telescope. Immediately, they pointed out that they had crystals supplied to him earlier. Nobili accepted that they possessed supplies of crystals but they were only a rudimentary knowledge of optics[7].

The Jesuits were working together on their Global Mission: The planetary model of Tycho Brahe (1546-1601) resembles that of Nilakanta Somasuutvan (1444-1550) and hence it has already been suggested that the Indian model was adapted and adopted by him[8]. His student was Johannes Kepler (1571-1630). Christoph Clavius (1538-1612) started the Collegio Romano to train Jesuits scientifically, so that they could locate scientific books, instruments etc., in India and China and bring them back[9]. Thus, Matteo Ricci ((1552-1610) and Nobili (1577-1656) were dispatched to China and India, but both met at Cochin and Goa to discuss their strategy[10]. Of course, all the three Rubino-Ricci-Nobili were sending books and instruments to Clavius, which reached Brahe-Galeleo-Kepler group[11].

Article from Sphaera: The Museum[12] of the History of Science at Oxford claims that it, "*has many fine oriental pieces in its collections. Amongst them is a sixteenth-century piece of Indian metalware known as the 'Bhugola' or 'Earth-Ball'. Essentially it is no more than a thin brass box roughly spherical in shape but its relevance for the Museum lies in the fact that on its outside is engraved a representation of the earth as known in Hindu cosmology*". The description as found in the website is given verbatim to understand the western interpretation of Indian subject even today (2007).

"*Brass boxes of circular section are among the most characteristic and common pieces of Indian metalware. They were usually used to store foodstuffs,*

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particularly the ingredients of 'pan' - the mixture of betel, lime and areca nut chewed all over Southeast Asia and the subcontinent. Probably the Bhugola was meant primarily only as a container and it was decorated in a manner considered appropriate to its shape.

"The representation of the earth as engraved on the Bhugola's surface is actually an attempt to reconcile ideas from two different systems: the traditional ideas of Hindu cosmography as set out in the Puranas, in which the universe is likened to an egg balanced on its big end divided in two by the crust of the earth (which is therefore of a flat-disc shape); and the concept of a spherical earth, which had been introduced with Ptolemaic astronomy by Sanskrit writers.

"The engraving is very rich, the general scheme being based around bands of land separated by seas, including a sea of milk and curds and one of sugar-cane juice. Land and sea are liberally populated with figures. Deities such as Brahma and Shiva are seen in the mountains while humans and animals inhabit the lowlands and are pictured in scenes representing the delights of a fertile land - parties of musicians playing instruments, dancers, groups of women talking, elephants bathing and turtles cavorting".

"Each area of the Bhugola is labelled in Sanskrit and as a whole it bears the inscription: 'In the Saka year 1493 in the region of the earth-lord Viraji by Ksema Karna the learned was the earth-ball created.'

Photo courtesy from: http://www.mhs.ox.ac.uk/database/imagel.htm?Imgno=156048

There is nothing wrong in using such gadgets modeled to suit secular use, as we find key-chains of different models or cigar-holders like telescopes. But the fact being that Indians used globes and represented world and countries on it, just like what we do now.

Indian Bhugola: The 'Bhugola' or 'Earth-Ball', as described, is a thin brass box, made in the 16th century, engraved with a representation of the earth as known in Hindu cosmology. However, the engraving is very rich, the general scheme being based around bands of land separated by seas, both liberally populated with figures. Deities such as Brahma and Shiva are seen in the mountains while humans and animals inhabit the lowlands. Each area of the Bhugola is labelled in Sanskrit and as a whole it bears the inscription: "***In the Saka year 1493 in***

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the region of the earth-lord Viraji by Ksema Karna the learned was the earth-ball created."

Incidentally, Circular box in two halves are connected with a hinge for closing so that when closed, it appears in the form of a sphere flattened at its lower end and rising to a peak at the apex of the upper half. On the outer surface has been etched a representation of the earth as known to traditional Hindu cosmology. The inscriptions are in devanagari character and the date is given in a chronogram and it is mounted on a later wooden stand with elephant supporters. Ironically, the stand has three elephants instead of four!

In traditional Hindu cosmography as set out in the Puranas, the universe is like an egg balanced upon its big end and divided by the crust of the earth into an upper celestial and a lower infernal part. The surface of the earth is divided into concentric rings of alternating land and sea. At the centre of these rings is Jambudvipa, a solid circular land-mass of which the southern quarter represented the Indian sub - continent (Bharatavarsu). It has been suggested that under the influence of Ptolemaic astronomy the concept of a spherical earth had been introduced by Sanskrit astronomers, causing a modification of traditional views to accommodate observations such that the southern extremities of the Indian peninsula lay close to the meridian. The representation of the earth shown in the bhugola in which the upper half consists primarily of land identified with Jambuvipa, displays a reconciliation of ideas from the two systems. Beneath the Indian land mass of the upper half of the box , is a sub-equatorial band representing the islands of Lanha (Ceylon) and Palanka, while the remainder of the lower hemisphere is divided into parallel rings representing the other six continents of Puranic geography and their intervening oceans.

Accepting its secular nature, the site notes that, "*Although the figures depicted on the box appear to have little devotional significance, the style of their representation and decoration adds something to the knowledge of the evolution of Indian style in the sixteenth century, the bhugola being among the few dated pieces surviving from this period*". Thus, it tries to suggest influence here also –

- ⇔ The patron Viraji mentioned in the inscription may speculatively be identified with a cadet of the Gohil Rowals family of Sihar in Saurashtra.
- ⇔ It is also possible that the maker of the piece is to be identified with Kham Koran a moderately prolific artist working at the court of the Emperor Akbar c. 1580 to the first decade of the seventeenth century.

So what difference it makes if, "The patron Viraji mentioned in the inscription may speculatively be identified with a cadet of the Gohil Rowals family of Sihar in Saurashtra" or "the maker of the piece is to be identified with Kham Koran " of Akbar period? When Tycho Brahe could get Brass globes, why not Akbar? So the attempted suggestion that this globe might have been copied Kham Khan etc., is meaningless, as the Arabs, Turks and all other middle-east categories obtained

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from India and sold in Europe, so the latter thought that they were "Moorish or Mohammedan".

Siddhantic evidences for Astronomical instruments including Globes, Armillary Spheres etc: There had been different types of Armillary spheres (Golabandha) described in the Siddhantic works:

- Bhubhagola (terrestrial and stellar sphere) – Surya Siddhanta, Chapter.XIII (1-16) [13].
- Kagolabanha (Sphere of the Sky) [14]
- Bagholabandha (Sphere of asterisms)
- Grahagolabandha (Sphere of planets)

Thus, from the period of Surya Siddhanta (c.3100-300 BCE / 5th to 11th centuries CE), it is evident that Globs and armillary spheres were used. The instruction for construction of wooden sphere has been so meticulous, there cannot be any doubt about its manufacture, existence and usage since that period. It is interesting and intriguing to note, Rev. Ebenezer Burgess[15] (1805-1870) ridicules such verses, as with is all scientific capacity, it is unbelievable that he could not understand such an easy description. Thus, it is evident that in spite of knowing that Indians had globes and armillary spheres, they wanted to suppress.

If anybody reads the verses of Gola or Sphericss (Section IV, verses.1-21), it would be clear that they could be understood only with practical demonstration of what is described shown on different spheres. Incidentally, the very next verse (22), Aryabhata[16] instructs, "***A light globe made of wood perfectly spherical and of even weight all round should be turned round by the observer till the unit of time through his intelligence by means of mercury, oil and water***". Thus, it is evident that Globes, armillary spheres and related astronomical instruments had not been myth, as without which, such observations could not have been made and recorded to bring out treatises, which are discussed and debated even today by scientists and mathematicians and astronomers. Again, it has to be noted that Aryabhata's date is given as –

- 3600 – 3101 = 499 – 23 = 426 CE (general interpretation reading 60 x 60 = 3600),
- 3623 – 3101 = 522 CE (Somesvara),
- 3101 – 360 = 2741 + 23 = 2764 BCE (based on some manuscripts which say 6 x 60 = 360 years).

There have been a lot of controversies about the manuscripts used by the scholars for such interpretation, as many times, the western scholars used Aryabhata II works taking them as that of Aryabhata I. This is mentioned to point out the lacuna persisting in the dating of works and authors in the context of material evidence. These two are discussed for the chronological implication on the material evidence. Of course, other works have ample evidences.

For the usage of wooden globes by Indians, one example is depicted as follows:

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www.alexandrefuchs.com/series/decayed_11.htm

It is in the private collection as claimed in the above website. As it is made of wood, the details could not be discerned. The globes used earlier must have deteriorated due to age. Thus, the absence of evidence cannot be treated as non-existence of evidence. As the textual evidence is available and as well as few material evidence, the usage of globes by Indian mathematicians, astronomers, geographers and others is established fact.

Conclusion: There have been many cosmological concepts, which have to be demythologized to get details on the evolution of cosmos, planets and earth. The representation of earth / world in the form of globe has been the direct evidence of concept of planets, revolution etc. Therefore, when such evidences were found in India, the Arabs and Europeans started using them for their development of science. However, during the colonization of India, Europeans adopted the strategy of carrying away all material evidences to suppress the antiquity and advancement of Indians by all means. They were bewildered to note that in every field, the Indians had been well ahead, thus, the inferiority complex, definitely worked to the extreme, thus leading to the suppression of evidences. However, recently, studies have taken reorientation to analyze the trade, commerce, finance and other economic aspects of the colonization, because of the liberalization, privatization and globalizations trends taking place. Thus, the locating an Indian globe has been an important aspect to interpret the Indian astronomy and geography even during medieval period. However, it does not mean that the

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usage of it could be placed in 15th-16th Centuries CE, but definitely goes back to Siddhantic and Mahabharat period (c.3100 – 300 BCE).

Notes and References

1. Christopher Clavius (1538-1612) was a "Jesuit friend" of Johannes Kepler (1571-1630) and chided by Tycho Brahe (1546-1601) for writing so many letters and supplier of manuscripts to Galelio Galeli, while visiting to the Jesuit Roman College (***Collegio Romano)***. Roberto de Nobili (1577-1656) of course worked with all.
2. Tycho Brahe, **Mechanica**, for details see ***Preface by Tycho Brahe to the noblest emperor Rudolph the 2nd***, in the following site:
   www.asu.cas.cz/~had/tychpref.html
3. Persian globe:
   http://www.loc.gov/bicentennial/gifts.html
4. Kapil Raj, ***Circulation and Emergence of Modern Mapping: Great Britain and Eatly Colonial India, 1764-1820***, in ***Relocating Modern Science – Circulation and Construction of Scientific Knowledge in South Asia and Europe***, Permanent Black, New Delhi, 2006.
5. For detailed information on Indian brass globe (Inventory no. 51703 - Old Label Text, Article from Sphaera, Indian Bhugola, Inventory no. 51703 - Additional photographic material, etc., see:
   http://www.mhs.ox.ac.uk/database/index.htm?text?ID=4047928
6. Tycho Brahe, ***opt.cit***.
7. Vincent Cronin, ***A Pearl to India – The Life of Roberto de Nobili***, Rupert Hart-Davis, London, 1959, pp.178-180.
8. K. Ramasubramanian et al, ***Modification of the earlier Indian planetory theory by the Kerala astronomers (c.1500) and the implied heliocentric picture of planetory motion***, Current Science, Vol.66, No.10, May, 1994, pp.784-790.
9. C. K. Raju, ***Computers, mathem,atic education, and alternative epistemology of the calculus in the Yuktibhasa***, Philosophy for East & West, 51 (3), 2001, pp.325-362.
   "***Com tudo nao me parece que sera impossivel saberse, mas has de ser por via d'algum mouro honorado ou brahmane muito intelligente que saiba as cronicas dos tiempos, dos quais eu procurarei saber tudo***", letter by Matter Ricci to Petri Maffei on 1 Dec. 1581, Goa **38** 1, ff 129r-130v, corrected and reproduced in Documenta Indica, XII, 472-477 (p.474). Also reproduced in Tacchi Venturi, Matteo Ricci S. J, Lettre Della Cina 1580-1610, vol.2, Macerata, 1613.

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10. ***Establishing Mathematical Authority: The Politics of Christoph Clavius***, see from the following site:http://www.stanford.edu/~mgorman/thesis/chapter1.pdf
The original quotation is as follows:
Io me ne stò in questo gran Regno di Bisnagà procurando la conversion di queste anime, ma per adesso clausa est ianua, stiamo aspettando, ch'il Signore l'apra, accioche si salvino tant'anime, che si miserabilmente se ne vanno all'Inferno. Questi Bramani, che sono i letterati
di questo regno sono molto dati alla cognit<ion>e delli movi<men>ti, et aspetti delli pianeti, e stelle, e principalmente di 27 per le quali si governano e reggono, e V.R. si stupirà come predicono l'hora, e minuto degl'eclissi cosi del sole, come della luna, con non sapere il modo come si faccino gl'eclipsi. Io pensai molte volte di farmi dichiarare il modo con che tirano gl'aspetti delli pianeti, ma non fu mai possibile a volermelo dichiarare, e le cose che sanno non le vogliono insegnare ad altri, se non a suoi parenti, et in secreto", Rubino to Clavius, Chandragiri, 25 October 1609, CC VI.1, 142-3, also in P. Tacchi Venturi, Alcuni lettere del P. Antonio Rubino D.C.D.G., Torino, 1901.

11. K. V. Ramakrishna Rao, ***The Transmission of Scientific Knowledge from Tamizhagam to Europe (15th to 20th centuries)***, to appear in the proceedings of Fourth Annual Human Empowerment Conference (HEC2006) held at Los Amgeles, Nov.17th-19th, 2006.

12. Simon Digby, ***The Bhugola of Ksema Karna: a dated piece of sixteenth century Indian metalwar***', Art and Archaeology Research Papers, 4 (1973), 10-31.

13. The date of Surya Siddhanta has been purposely made controversial by the western and Jesuit scholars, evidently, as they did not want it to place before Aryabhata or even Varahamihira to strengthen their "India borrowing from Greece theory". One need not go the extremes of 21,64,960 YBP as pointed out by Ebenezer Burgess or 11th century by John Bentley. The earlier dating has been the traditional that the knowledge came down from the Krutayuga and the latter fixed by Bentley based on his own way of reading Sanskrit verses and interpreting with forged works with the sole intention to reduce Indian chronology. But assigning it to Mahabharat period (c.3100 BCE) has been definitely reasonable, as it is supported by astronomical and archaeological evidences.

14. B. V. Subbarayappa and K. V. Sarma, ***Indian Astronomy – A Source-Book (Based on primarily Sanskrit Texts)***, Nehru Centre, Bombay, 1985, pp.74-80.

15. Ebenezer Burgess, ***The Surya Siddhanta***, Motilal Banarasidas, New Delhi, 1989 (1860), pp.298-304.

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